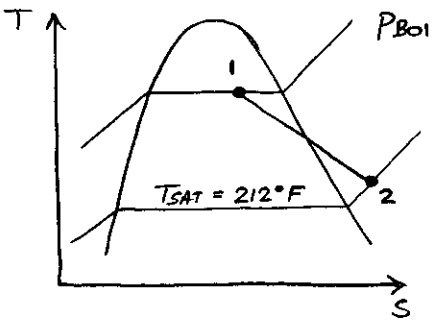
THROTTLING CALORIMETER

STEAM IS EXTRACTED FROM A BOILER AND SENT TO A THROTTLING CALORIMETER KEPT AT A TEMPERATURE OF 250°F. THE BOILER PRESSURE IS 500 PSIA.

FIND: STEAM QUALITY, X [%], OF THE EXTRACTED STEAM



P_{BOIL} = 500 PSIA

P_{CAL} = 14.7 PSIA

↑ CALORIMETER IS KEPT AT PATM TO PROVIDE A KNOWN, FIXED PRESSURE

1→2 AS SHOWN ON THE ABOVE T-S DIAGRAM IS A LINE OF CONSTANT ENTHALPY (h).

NOTES

(1) 1→2 ISENTHALPIC (THROTTLING)

(2) STATE PT 2 IS S/H BECAUSE 250°F > T_{SAT} OF 212°F IN THE CALORIMETER.

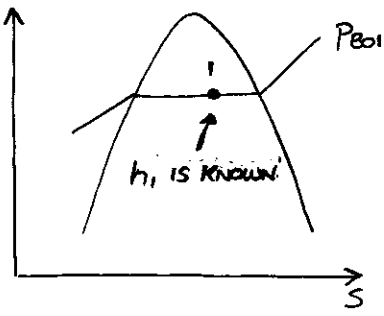
(3) STATE PT 1 IS SAT. STEAM BECAUSE THIS PROBLEM STATES THAT THE BOILER STEAM HAS SOME STEAM QUALITY X (WHICH YOU MUST FIND).

SOLN: THE KEY HERE IS TO UNDERSTAND <u>THROTTLING</u> IS AN <u>ISENTHALPIC</u> PROCESS ($h_1 = h_2$)

So, LOOK UP h_2 @ 14.7 PSIA, 250°F IN TABLE 3: $h_2 = 1168.8 \frac{Btu}{lbm}$

Now, $h_2 = h_1 = 1168.8 \frac{Btu}{lbm}$

So, WE NOW FOCUS ON:



P_{BOIL} = 500 PSIA

SOLVE FOR STEAM QUALITY X_1:

$$h_1 = h_f + X_1 (h_{fg})$$

↓

, h_f AND h_{fg} FROM TABLE 2 AT 500 PSIA

$$1168.8 = 449.5 + X_1 (755.1)$$

$$\boxed{X_1 = .953 = 95.3\%}$$

STEAM QUALITY

NOTE: <u>MOISTURE CONTENT</u> AT PT 1 WOULD BE

$m_1 = 1 - X_1 = 4.7\%$